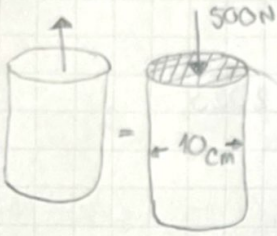
RESISTENCIA

1 Ton = 1.000 kg

N = kg (9,8 m/s²)

* Esfuerzo normal ⇒ $\sigma = F/A$



$\sigma = \frac{500\ lb}{\pi/4\,(10)^2} = 6,36\ Psi$

$\sigma = \frac{500}{\pi/4\,(0,1)^2} = 63662$ ⇓ 63,6 kPa

$\frac{F}{A} = \frac{N}{m^2} = Pa$ (Pascal)

Unidades	Inter	Ingles
F =	N	lb
A =	m^2	In^2
L =	m	In
T =	S	S
σ =	Pa	Psi
∂ce =	m/s^2	Ft/s^2

entre menor área mayor esfuerzo

* esfuerzo de Kenny

$\sigma = \frac{627\ N}{0,024} = 26125\ Pa \Rightarrow 26,12\ kPa$

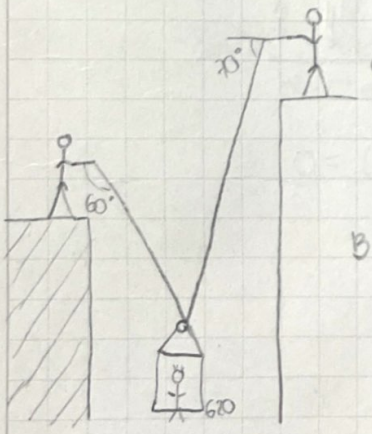
* esfuerzo Valla.

$\sigma = \frac{603}{0,016} = 37937\ Pa = 37,93\ kPa$

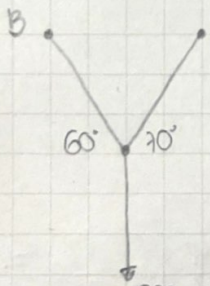
07/09/23

$N = \frac{F}{A}$ $\quad \sigma$

$\emptyset = 1\ in \cdot \frac{2.54\ cm}{1\ in} \cdot \frac{1\ m}{100\ cm} \Rightarrow 0,0254\ m$



Hallar los esfuerzos del cable de $\emptyset = 1\ in$



$-620 + (1.46\ FB)\ Sen(70) + FB \cdot Sen(60) = 0$

$-620 + FA \cdot Sen(70°) + FB \cdot Sen(60°) = 0$

$FA \cdot Cos(70°) - FB \cdot Cos(60°) = 0$

$FA = \frac{FB \cdot Cos(60°)}{Cos(70°)}$

$FA = 1,46\ FB$

FA = 1042 N

FB = 714,3 N

Primavera

Disney 100

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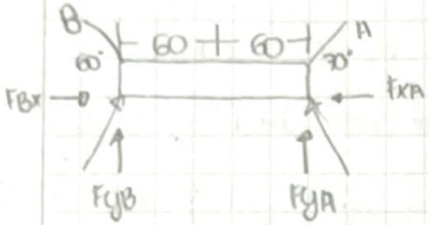
$\sigma_A = \frac{1042}{\pi/4\,(0{,}0254)^2} = 2\,056\,413$ Pa
$2{,}05$ mPa

$\sigma_B = \frac{714}{\pi/4\,(0{,}0254)^2} = 1\,409\,097$ Pa
$1{,}4$ mPa

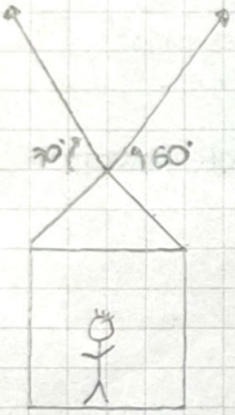
) Respuestas en mega Pascales

mismo ejemplo pero estan sosteniendo a una persona en una banca.



11/09/2023.

Hallar los esfuerzos del cable $\phi_1 = 1.5''$
$\phi_2 = 2''$



$1{,}5'' \cdot \frac{2.54\text{ cm}}{1''} \cdot \frac{1\text{ m}}{100\text{ cm}} = 0{,}0381\text{ m}$

$2'' \cdot \frac{2{,}54\text{ cm}}{1''} \cdot \frac{1\text{ m}}{100\text{ cm}} = 0{,}0508\text{ m}$

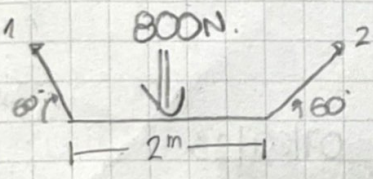
$\pm \sum F_x = 0$.

$F_2 \cdot \cos(60^\circ) = F_1 \cdot \cos(60^\circ)$

$F_2 = F_1$

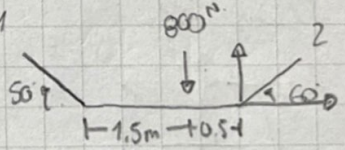
$+\uparrow \sum F_y = 0$.

$F_2 \cdot \operatorname{Sen}(60^\circ) + F_1 \cdot \operatorname{Sen}(60^\circ) = 800$



$2(F_1 \cdot \operatorname{Sen}(60^\circ) = 800$.

$F_1 = 461$ N



$\pm \sum F_x = 0$.

$-F_1 \cdot \cos(60^\circ) + F_2 \cos(60^\circ) = 0$.

$F_2 = 1.28\, F_1$.

$F_1 = 540$ N

$+\circlearrowleft m_A = 0$.

$-800(1.5) + (F_2 \cdot \operatorname{Sen}(60))(2) = 0$

$F_2 = 692$ N.

$\sigma_1 = \frac{461}{\pi/4 \cdot (0.0381)^2} = 404353$ Pa
$0{,}404$ mPa
$404{,}3$ kPa

$\sigma_2 = \frac{461}{\pi/4 \cdot (0{,}0508)^2} = 227448$ Pa
$0{,}227$ mPa
$227{,}4$ kPa

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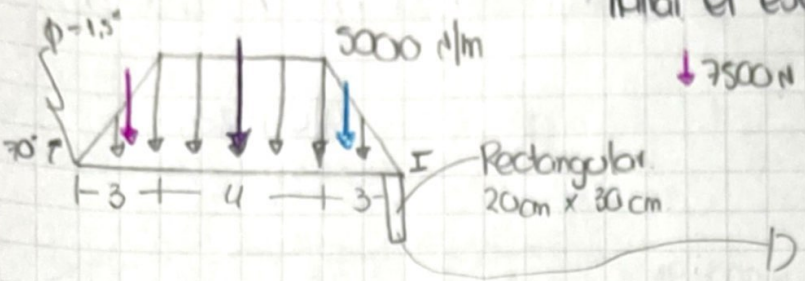
$$\sigma_1 = \frac{540}{\pi/4 \cdot (0{,}0381)^2} = 473{,}6 \text{ kPa}$$

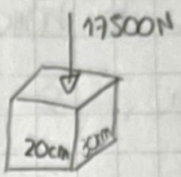
$$\sigma_2 = \frac{692}{\pi/4 \cdot (0{,}0508)^2} = 341{,}4 \text{ kPa}$$

Hallar el esfuerzo en la barra y el cable.



↓7500 N ↓20000 N ↓7500 N

Rectangular 20cm x 30cm



$+\circlearrowleft \Sigma M_A = 0$

$-7500(2) - 20000(5) - 7500(8) + I(10) = 0$

$I = 17.500 \text{ N}$

$$\sigma = \frac{17500}{(0{,}2 \cdot 0{,}3)} = 291 \text{ kPa}$$

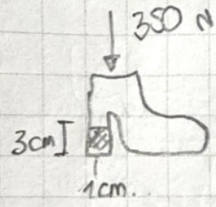
$+\uparrow \Sigma F_y = 0$

$17500 - 7500 - 20000 - 7500 + \text{Cable} \cdot \text{Sen}(70^\circ) = 0$

$\text{Cable} = 18600 \text{ N}$

$$\sigma \text{ cable} = \frac{18600}{\pi/4\,(0{,}0381)^2} = 16 \text{ MPa}$$

Hallar el esfuerzo del tacon con el barra.



• Pesa 700 N la chica.

$$\sigma \text{ normal} = \frac{350}{\pi/4\,(0{,}01)^2} = 4 \text{ MPa}$$

$$\sigma \text{ cortante} = \frac{350}{9{,}4 \times 10^{-4}} = 0{,}7372 \text{ MPa}$$

Primavera Disi

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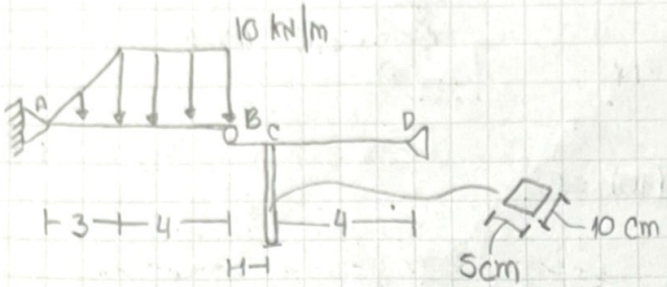
Hallar los esfuerzos en el material.

$\sigma_{cortante} = \frac{400}{2(\pi/4 \cdot 0^2)} = \frac{400}{S(A)}$

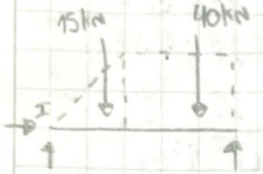
14/09/23.

Hallar el esfuerzo de la barra. C



$\sigma = \frac{41,075}{(0,05 \cdot 0,1)} \Rightarrow 8,2$ mPa

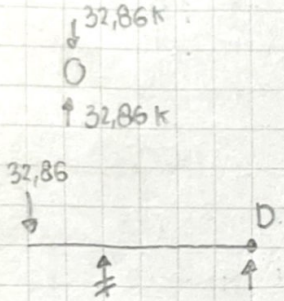
Lim 22m / 8m = 2,6 Factor de seguridad



$\sum m_I)^+ = 0$

$-15(2) - 40(5) + B(7) = 0$

$B = 32,86$ kN



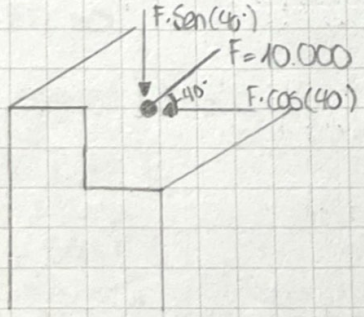
$\sum m_D)^+ = 0$

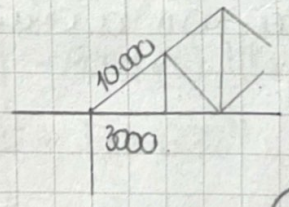
$32,86(5) - C(4) = 0$

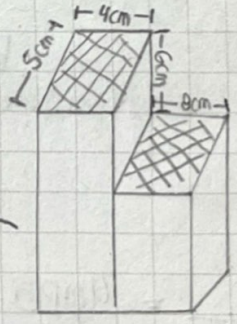
$C = 41,075$ kN

18/09/23.

Hallar los esfuerzos







esfuerzos verticales.

$10.000 \cdot Sen(40°) = 6427$

$\sigma = \frac{F}{A} \Rightarrow \frac{6427}{(0,05 \times 0,04)} = 3,213$ mPa

$\sigma = \frac{F}{A} \Rightarrow \frac{6427}{(0,05 \times 0,08)} = 1,606$ mPa

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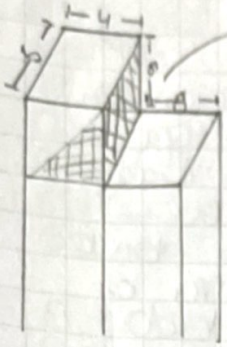
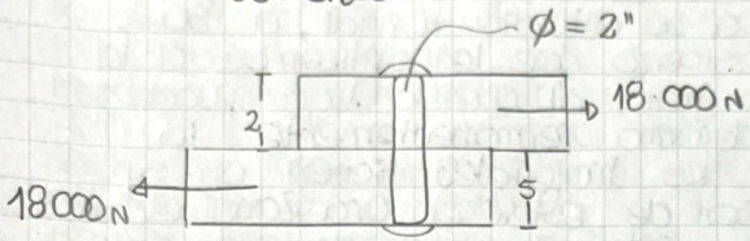


esfuerzos horizontales

$$\sigma = \frac{F}{A} = \frac{10.660}{(0,06 \times 0,05)} = 3,553 \text{ mPa}$$

$$\sigma = \frac{F}{A} = \frac{10.660}{(0,05 \times 0,04)} = 5,330 \text{ mPa}$$

Hallar los esfuerzos.



2" => 0,0508 m

$$\sigma = \frac{F}{A} = \frac{18000}{\pi/4\,(0,0508)^2} = 8,8 \text{ mPa}$$

el tornillo se parte con el esfuerzo.

$$\sigma = \frac{F}{A} = \frac{18000}{(0,07 \times 0,0508)} = 5,06 \text{ mPa}$$

el tornillo se aplasta y el área se ve como un cuadro.

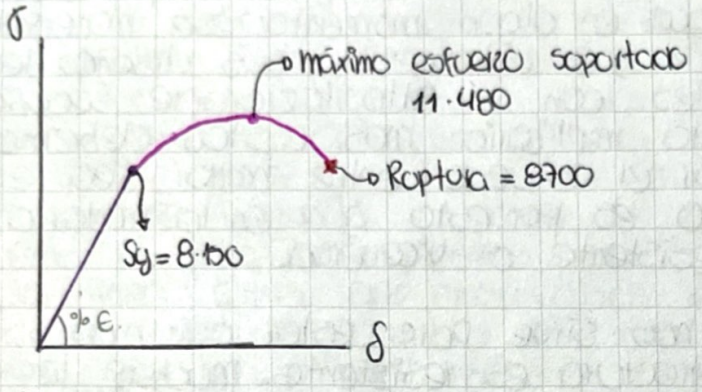
δ = deformación

Laboratorio de Resistencia

21/09/23

- Hay materiales frágiles que no fallan por peso pero sí por impacto y fallan limpios, y hay materiales dúctiles que fallan por peso y no por impacto y este material si trata de no deformarse y por eso aveces o en algunos materiales salen algunos estrics o estiramientos.
- las fundiciones son frágiles y el acero dúctil.

Gráfica del laboratorio.



medidas.

L inicial = 40 cm
D con vena = 17,52 mm
D sin vena = 15,58 mm
entre línea y línea = 20 cm

L final = 46 cm
D con vena = 12,16 mm
D sin vena = 12,07 mm
entre línea y línea = 24 cm

$Sy = 8.150\ kg \cdot 9,8\ m/s^2 = 79.87\ kN$

Diametro de la barra con vena $= 17,52\ mm \times \frac{1m}{1000mm} = 0,01752$

$$\sigma = \frac{79.87}{\pi/4\ (0,01752)^2} = 331\ MPa$$

módulo de elasticidad
módulo de fluencia.
módulo de Young
] - inclinación $\Rightarrow \epsilon$

ϵ en acero = 210 GPa

- entre mas inclinada este se deforma menos

$$\delta = \frac{PL}{A\epsilon}$$

- en elasticidad los materiales son reutilizables.

elongación $= \frac{l_0}{l_f} = \frac{20}{24} = 0,83\% \Rightarrow 1 - 0,83 = 17\%$

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25/09/23.

- elongación = es el porcentaje que indica cuanto se estira un material.

* entre mas alto el porcentaje de elongación más se puede estirar el material y viceversa

Formula laboratorio

$\frac{L_0}{L_F} = X \Rightarrow 1 - X =$ elongación.

ejemplo

$\frac{20}{24} = 0{,}83\% \Rightarrow 1 - 0{,}83\% = 17\%$

Formula Ingeniería.

$\frac{L_F - L_0}{L_0} \rightarrow X$ (elongación)

$\epsilon = \frac{\Delta L}{L_0} = X$

$\Delta L = \delta$

ejemplo.

$\frac{24 - 20}{20} = 0{,}2\%$

son diferentes los datos obtenidos pero es lo mismo.

E = Inclinación.
ϵ = elongación.
δ = deformación.

Formulas de esfuerzo.

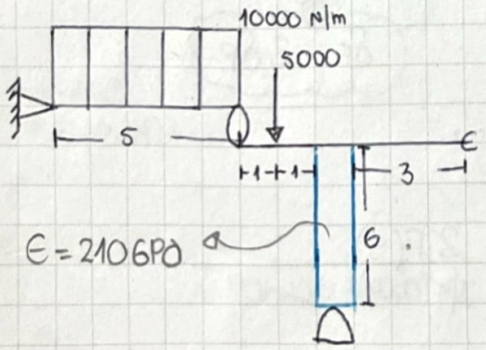
$\sigma = \frac{P}{A}$ $\quad \sigma = E \cdot \epsilon \Rightarrow E \cdot \frac{\delta}{L_0}$

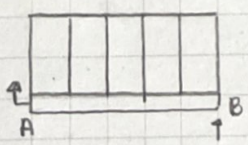
$\sigma = \sigma \Rightarrow \delta = \frac{PL}{A \cdot E}$

Club comercio = lunes.

Av 1 calle 16 - 17 frente a los montes

Hallar la deformación de la barra Azul.

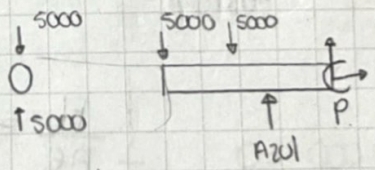




$\Sigma m_A = 0$

$-10.000(2.5) + B(5) = 0$

$B = 5000$ N.



$\Sigma m_P = 0$

$5000(5) + 5000(4) - Azul(3) = 0$

$Azul = 15.000$

$\delta = \frac{(15.000)(6)}{(0{,}1 \times 0{,}05)(210GPa)} = 8{,}57 \times 10^{-5}$ m

0,0000857 m

$\frac{N \cdot m}{m \cdot m \cdot \frac{N}{m^2}}$

Primavera
Disney 100
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Elasticidad $\Rightarrow E$

madera $\Rightarrow$ 50 GPa

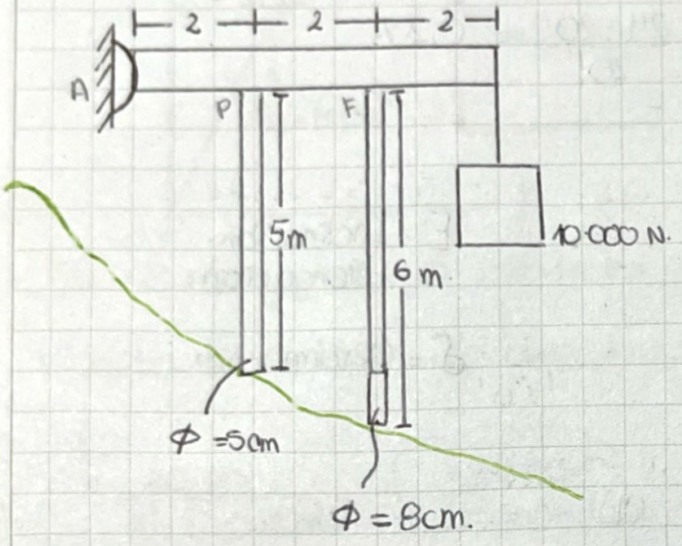
Acero $\Rightarrow$ 210 GPa

Cobre $\Rightarrow$ 70 GPa

Aluminio $\Rightarrow$ 90 GPa

28/09/23.

Ejercicio 1. Hallar la deformación y el esfuerzo de cada madera.

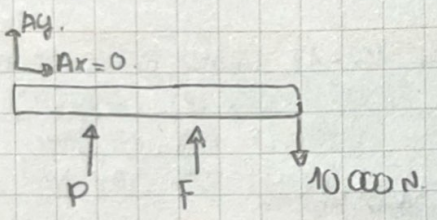


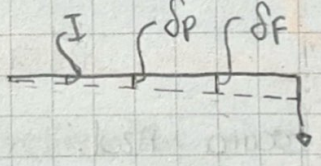
Deformación = $P =$

$F =$

esfuerzo = $P = 1{,}604$ mpa.

$F = 2{,}670$ mpa.





$\Rightarrow \frac{\delta F}{4} = \frac{\delta P}{2}$

$\delta F = 2\delta P$

$\Sigma F_y \uparrow^+ = 0$

$Ay + P + F - 10.000 = 0$

$\Sigma (MA)^+ = 0$

$P(2) + F(4) - 10000(6) = 0$

$2P + 4(4{,}26P) - 10.000(6) = 0$

$P = 3151\ N$

$F = 13423\ N$

$= \frac{Fl}{AE} = \frac{2Pl}{AE}$

$\frac{F(6)}{\pi/4(0{,}08)^2 \cdot 50\times10^9} = \frac{2P(5)}{\pi/4(0{,}05)^2 \cdot 50\times10^9}$

$\frac{F(3)}{(0{,}08)^2} = \frac{P(5)}{(0{,}05)^2}$

$F = \frac{(0{,}08)^2\ 5P}{3(0{,}05)^2} = 4{,}26\ P.$

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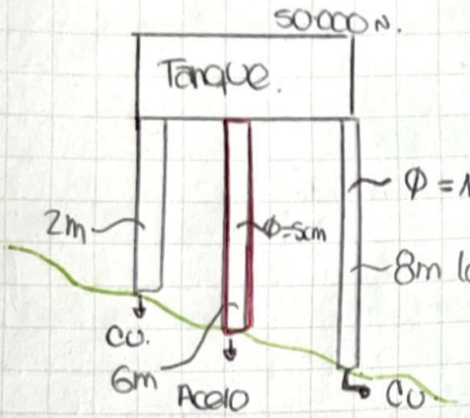
$\sigma_P = \frac{3151}{\pi/4\,(0{,}05)^2} = 1{,}604$ mpa

$\delta_P = \frac{(3151)(5)}{\pi/4\,(0{,}05)^2 \cdot 50 \times 10^9} =$

$\sigma_F = \frac{13423}{\pi/4\,(0{,}08)^2} = 2{,}670$ mpa

$\delta_F = \frac{(13423)(6)}{\pi/4\,(0{,}08)^2 \cdot 50 \times 10^9} =$

ejercicio 2. Hallar el esfuerzo y la deformación de cada madera.



$\Sigma F_{\uparrow} = 0$.

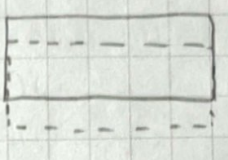
$Cu + Fe + Cu = 50.000$.

$2Cu + Fe = 50.000$.

$3Fe = 50.000$.

$Fe = 16666$.

$\sigma = \frac{16666}{\pi/4\,(0{,}01)^2}$



$= \delta_{Fe} = \delta_{Cu}$

$\frac{P_{Fe}\, l_{Fe}}{\pi/4\,(\Phi_{Fe})^2 \cdot 210 \times 10^9} = \frac{P_{Cu}\, l_{Cu}}{\pi/4\,(\Phi_{Cu})^2 \cdot 70 \times 10^9}$

$\frac{P_{Fe}\,(6)}{(0{,}05)^2 \cdot 3} = \frac{P_{Cu}\,(8)}{(0{,}01)^2}$

$Fe = \frac{P_{Cu}(8)(0{,}05)^2(3)}{(0{,}01)^2(6)} = 1$

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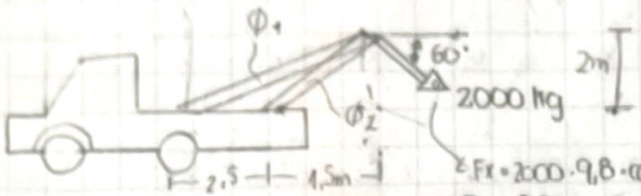
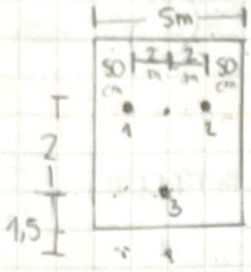
ejercicio 1. Hallar los esfuerzos de los tubos. 05/10/23



Φ1 = 5cm (solido)

Φ2 = 8cm, 7cm



$T_3 = (-1,5 \quad -2 \quad 0) = \sqrt{(1,5)^2 + (2)^2 + (0)^2} = 2,5$

$T_1 = (-4 \quad -2 \quad 2) = \sqrt{(4)^2 + (2)^2 + (2)^2} = 4,9$

$T_2 = (-4 \quad -2 \quad -2) = \sqrt{(4)^2 + (2)^2 + (2)^2} = 4,9$

X (i)	Y (j)	Z (k)	
$\frac{-1,5\,T_3}{2,5}$	$\frac{-2\,T_3}{2,5}$	$\frac{0\,T_3}{2,5}$	ΣF
$\frac{-4\,T_1}{4,9}$	$\frac{-2\,T_1}{4,9}$	$\frac{2\,T_1}{4,9}$	
$\frac{-4\,T_2}{4,9}$	$\frac{-2\,T_2}{4,9}$	$\frac{-2\,T_2}{4,9}$	

$\Sigma Fx = 0$

$-0,6\,T_3 - 0,81\,T_1 - 0,81\,T_2 + 9800 = 0$

$\Sigma Fy = 0$

$-0,8\,T_3 - 0,4\,T_1 - 0,4\,T_1 - 16974 = 0$

$\Sigma Fz = 0$

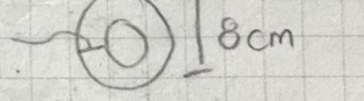
$0 + 0,4\,T_1 - 0,4\,T_2 = 0$

calculadora

$T_1 = 22088$

$T_2 = 22088$

$T_3 = -43306$



Factor de seguridad

$\sigma_3 = \frac{43.306}{\pi/4\,(0,05)^2} = (22\,mPa) \Rightarrow 110/22 = 5$

$\frac{\pi}{4}(0,08)^2 - \frac{\pi}{4}(0,07)^2$

$\sigma_1 = \frac{22088}{\pi/4\,(0,08^2 - 0,07^2)} = (18\,mPa) \Rightarrow 110/18 \Rightarrow 6,1$

$\frac{\pi}{4}(0,08^2 - 0,07^2)$

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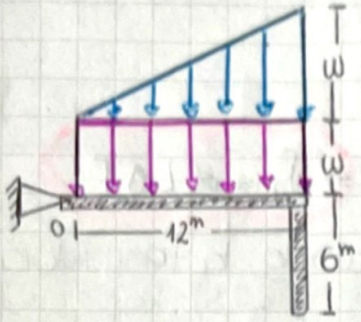
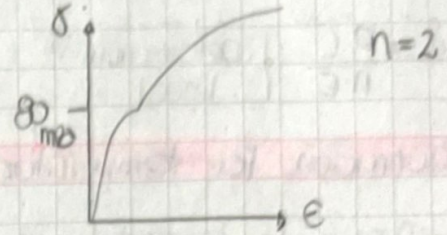
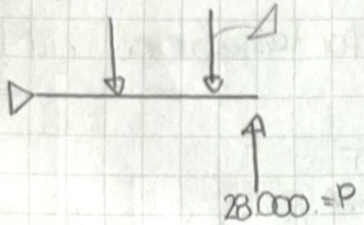
ejercicio 1. Previo 09/10/23.

1) Hallar la carga maxima w que soporta el sistema.
2) Hallar la deformación de la barra si el diámetro es de 3cm.





1)



$Sy/n = \sigma$

$80/2 = 40 mpa$

$\sigma = \frac{P}{A} \Rightarrow 40mpa = \frac{P}{\pi/4(0,03)^2}$

$\Sigma m_0 \circlearrowleft + = 0$

$P = 28.000$

$28000(12) - w(12)\cdot(6) - \frac{w(12)\cdot 8}{2} = 0$

$w = 72(w) + 48(w) = 336000$

$w = \frac{336.000}{120}$

$w = 2800$ ⇒ Carga máxima que soporta el sistema

2) $\delta = \frac{P \cdot L}{A \cdot E}$

$\delta = \frac{(28000)(6)}{\pi/4(0.03)^2 (210.000.000.000)} = 0,001131 \Rightarrow \delta = 0,1131\,m$

deformación de la barra $\phi = 0,03\,m$.

12/10/23.

Est. normal

$\sigma = \frac{F}{A}$ | • Factor de seguridad n.
• curva est - def.

$\delta = \frac{P \cdot L}{A \cdot E}$ | • deformación lineal

Deformación Por temperatura. (Dilatación térmica). $\Rightarrow \delta_T = \alpha L \Delta T$

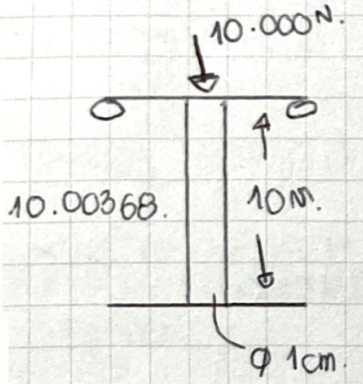
- Cuando la temperatura baja la longitud baja y cuando la temperatura sube la longitud sube.
- Solo los materiales ferrosos tienen deformación por temperatura.

Deformación Por temperatura.

aluminio = 23×10^{-6} C°
cobre = 17×10^{-6} C°
Acero = 11×10^{-6} C

$\delta_T = \alpha L \Delta T$
α → coeficiente deformación
ΔT → $(T_F - T_0)$.

Ejercicio 1. Hallar la deformación total (Aluminio).



$24° - 40°$

$\delta_T = \alpha L \Delta T$

$\delta_T = 23 \times 10^{-6} \left(\frac{1}{C°}\right) (10m)(40° - 24°) C°$

$\delta_T = 3{,}68 \times 10^{-3} m \Rightarrow 0{,}00368 m$

$\delta = \delta_{carg} + \delta_{temp.}$

$\delta = -\frac{(10.000)(10)}{\pi/4\,(0{,}01)^2 (210 \times 10^9)} + (11 \times 10^{-6})(10)(16) =$

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Esfuerzo a torsión.

09/12/23.

$\sigma = \frac{T \cdot r}{J}$ $\quad \phi = \frac{T \cdot l}{G \cdot J}$

momento = F · D ⇒ T

Fuerza Radio.

R ⇒ Radio.

J ⇒ Capacidad de que el objeto rote. $\pi/2\, r^4$

l = longitud

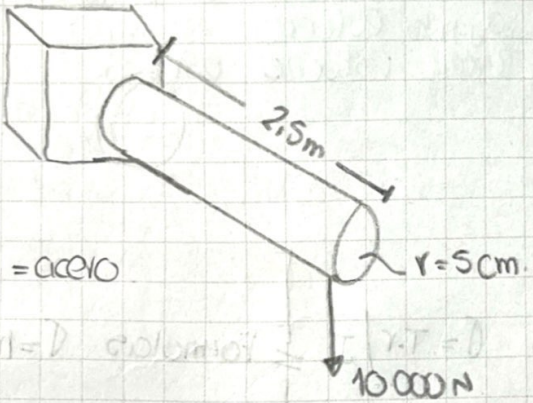
T = momento = F · D

$J = \pi/2\,(r)^4$

G = Rango de estabilidad. $E/3 \leq G \leq E/2$

G acero ⇒ 90 GPa

Ejercicio 1. Hallar el ángulo de giro final y el esfuerzo en el eje.



material = acero

Esfuerzo = $2,54 \times 10^6$ Pa

T = (10000N × 0,05m) = 500 N.m

r = 0,05 m

$J = \pi/2\,(0,05m)^4 = 9,81 \times 10^{-6}\ m^4$

$\sigma = \frac{(500 N.m)(0,05m)}{9,81 \times 10^{-6} m^4} = 2,54 \times 10^6$ Pa

Ángulo = 0,08°

$\phi = \frac{(500 n.m)(2,5m)}{(90GPa)(9,81 \times 10^{-6} m^4)}$

$\phi = 1,41 \times 10^{-3}$ rad ⇒ 0,08°

$1 rad \times \frac{180°}{\pi} = \phi$

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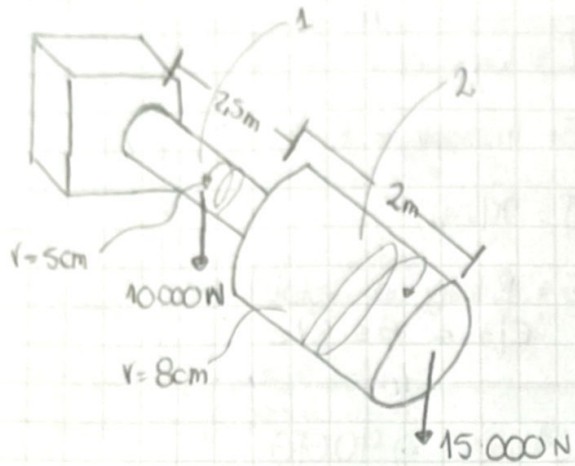
Ejercicio 2. Hallar el angulo de giro final y el esfuerzo en el eje.



Esfuerzo.

$T = T_2 - T_1$
$T = (15000 N \times 0{,}08 m) - (10000 N \times 0{,}05 m)$
$T = (1200 N.m - 500 N.m)$
$T = 700 N.m$

$\sigma_1 = \frac{(700 N.m)(0{,}05 m)}{9{,}81 \times 10^{-6}}$

$\boxed{\sigma_1 = 3{,}56 MPa} \Rightarrow 1$

$\sigma_2 = \frac{(1200 N.m)(0{,}08 m)}{\pi/2\,(0{,}08)^4}$

$\boxed{\sigma_2 = 1{,}49 MPa} \Rightarrow 2$

Primer esfuerzo es la resta.
Segundo esfuerzo Suma.
Tercer esfuerzo estatico.

Angulo

$\Phi_1 = \frac{(700)(2{,}5)}{(90 \times 10^9)(\pi/2 \cdot 0{,}05^4)} =$

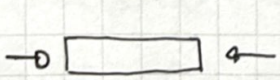
$\Phi_2 = \frac{-(1200)(2)}{(90 \times 10^9)(\pi/2 \cdot 0{,}08^4)} =$

$\Phi = 1 - 2$

$\Phi =$

Formulas $\sigma = P/A$

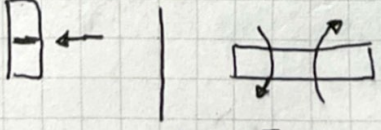
$\delta = \frac{P.L}{A.E}$ $\quad \delta_T = \alpha . l . \Delta . T$



Lineal

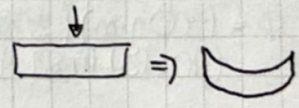
Formulas $\sigma = T.r/J$

$\phi = \frac{T.L}{G.J}$



Torsión.

Formulas $\sigma = m.c/I$



Flexión.

Sy → límite de fluencia.

Factor de seguridad

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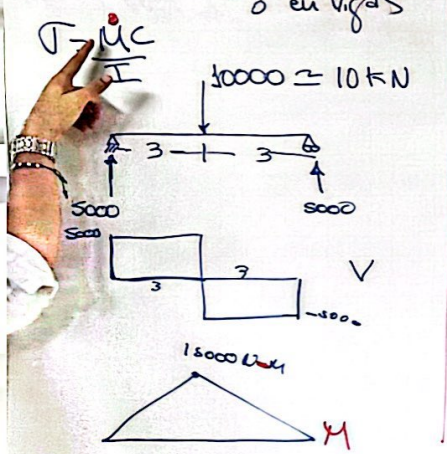
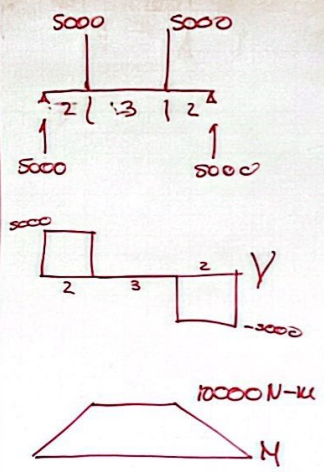
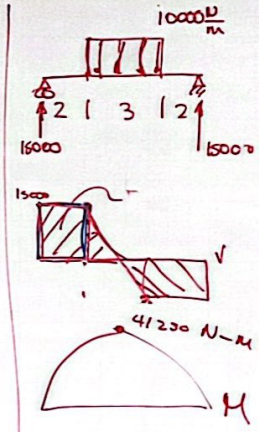
Deformación a flexion o en Vigas

$\sigma = \frac{Mc}{I}$







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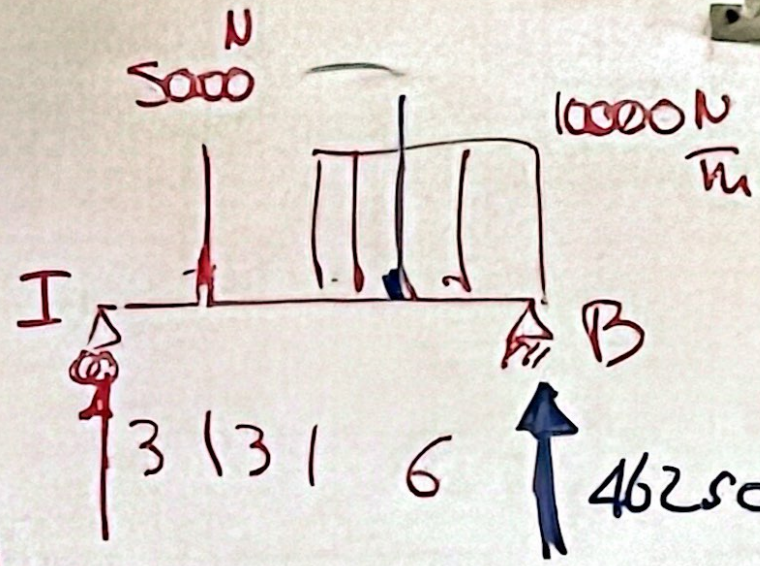
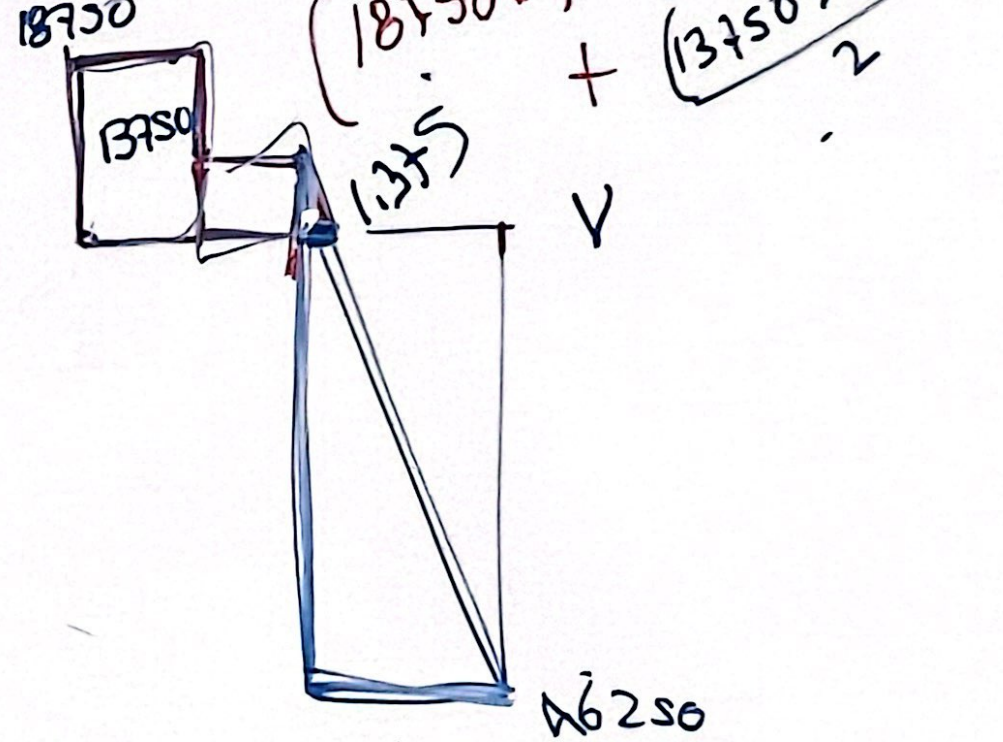


$+)\Sigma M_I = 0$

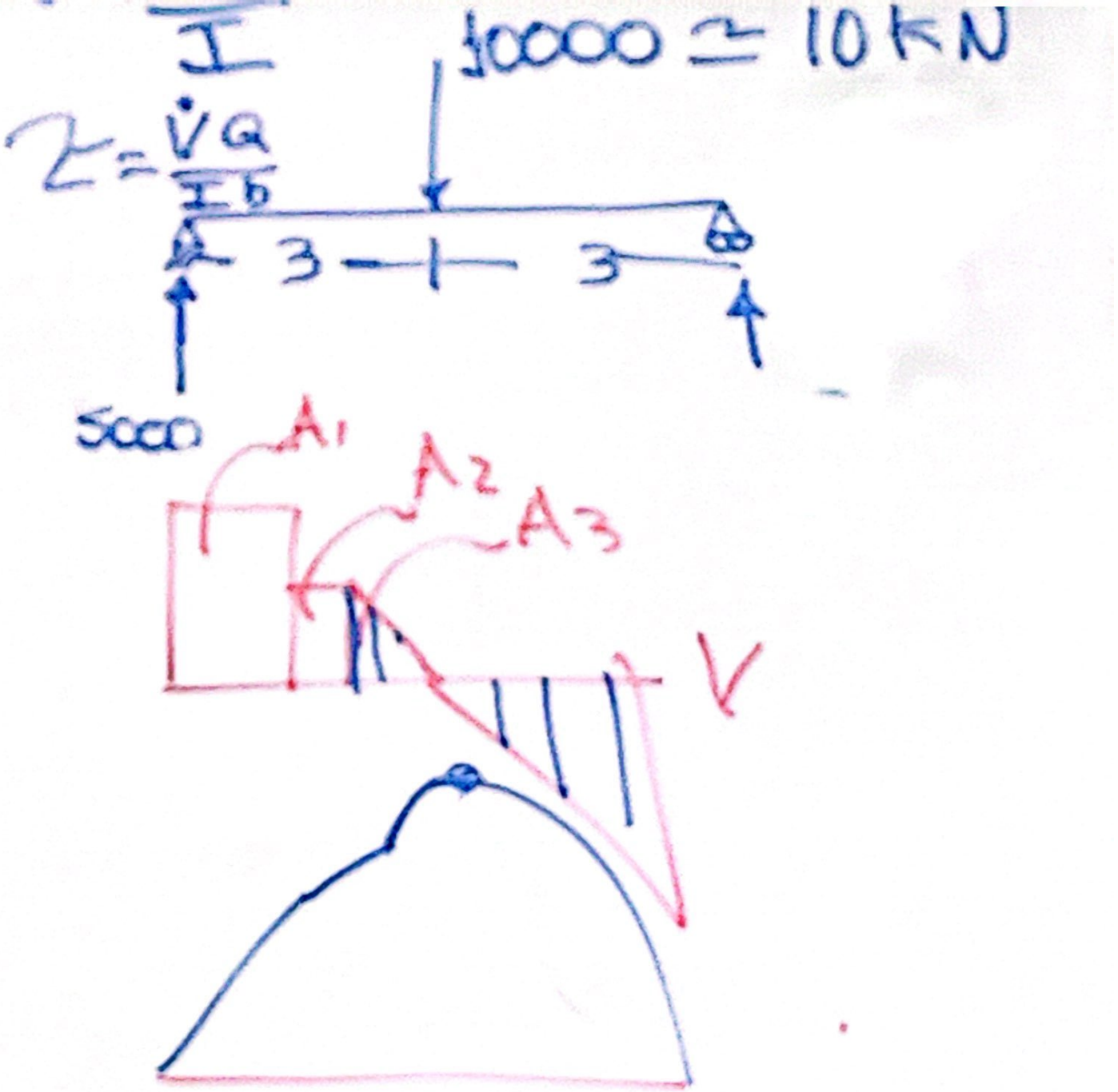
$-5000(3) - (10000 \cdot 6)(9) + B(12) = 0$

$B = 46250$

$A = 18750$



$(18750 \cdot 3) + (13750 \cdot 3) + \frac{(13750 \cdot 1.375)}{2} =$



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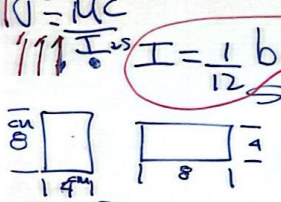
Deformación a flexion o en Vigas

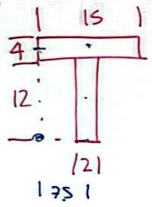
$\sigma = \frac{Mc}{I_{xx}}$

$I = \frac{1}{12} bh^3$



$I = \frac{1}{12}(0.08)(0.08)^3$

$1.70 \times 10^{-6}\ m^4$



$\frac{1}{12}(8)(9)^3$

4.26×10^{-7}

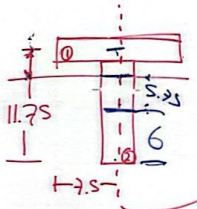
0.000000 4.26

0.00000 1.70

$I = \frac{1}{12} bh^3 + Ad^2$

Cuerpo	Area		Y	Ax	Ay
15 / 4	4×15	7.5	14	450	840
12 / 2	12×2	7.5	6	180	144
	84			630	984

$\bar{x} = \frac{630}{84} = 7.5$ $\quad \bar{y} = \frac{984}{84} = 11.75$



$I = \frac{1}{12}(0.15)(0.04)^3 + (0.15 \times 0.04)(2.25)^2 + \frac{1}{12}(0.02)(0.12)^3 + (0.02 \times 0.12)(5.75)^2$

$=$